A Poorly Treated Carotid-Cavernous Fistula Rescued by Coils through a PComA Approach

A Case Report

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Summary

This study describes a case of traumatic carotid-cavernous fistula poorly treated with balloons and rescued by coils through a PComA approach. A six-year-old boy suffered a left temporal bone puncture wound. Digital subtraction angiography disclosed a left carotid cavernous fistula. Five balloons were implanted into the cavernous sinus and the parent artery was sacrificed unwillingly, but the residual fistula retro-engorged by the ophthalmic artery communicated with the maxillary artery and the post circle through the PComA. We finally occluded the residual fistula through the PComA with coils. Once the parent artery was sacrificed and the distal residual fistula still retro-engorged, another patent communicating artery may be a rescue approach.

Introduction

Carotid cavernous fistula (CCF) mostly results from head injury. The blood leaks into the cavernous sinus directly from internal carotid artery (ICA) through the fistula orifice. Sometimes, aneurysms located in the cavernous segment of the ICA rupture into the cavernous sinus and spontaneously lead to CCF. They all belong to Type A classified by Barrow [1] . It is easy to diagnose CCF from the symptoms such as intracranial pulsatile tinnitus, eye proptosis, bulbar conjunctival hyperemia and diplopia after head injury. Types B, C, and D have been incorporated into cavernous sinus dural arteriovenous fistulae. Transarterial embolization of direct CCF with detachable balloons has been proven to be the best option for initial treatment [3,4]. We treated such a traumatic CCF via transarterial approach using detachable balloons and coils.

Case Report

A six-year-old boy was admitted to our department for a left temporal bone puncture wound 68 days previously. Head computed tomography (CT) revealed left temporal cerebral contusion. The patient exhibited left eye exophthalmos, chemosis, conjunctival edema, sight weakness, pupil dilatation, dys-oculomotor, diplopia and bilateral orbital bruit. At that point, a traumatic CCF was suspected. A diagnostic cerebral angiography performed under general anesthesia showed left high-flow CCF. The C4 segment of the left ICA was nearly transsected with an absence of filling of the ICA above the fistula.

The blood leaked into the cavernous sinus from the left ICA directly with venous drainage from the ipsilateral left sylvian vein to the longitudinal sinus, from the ipsilateral inferior

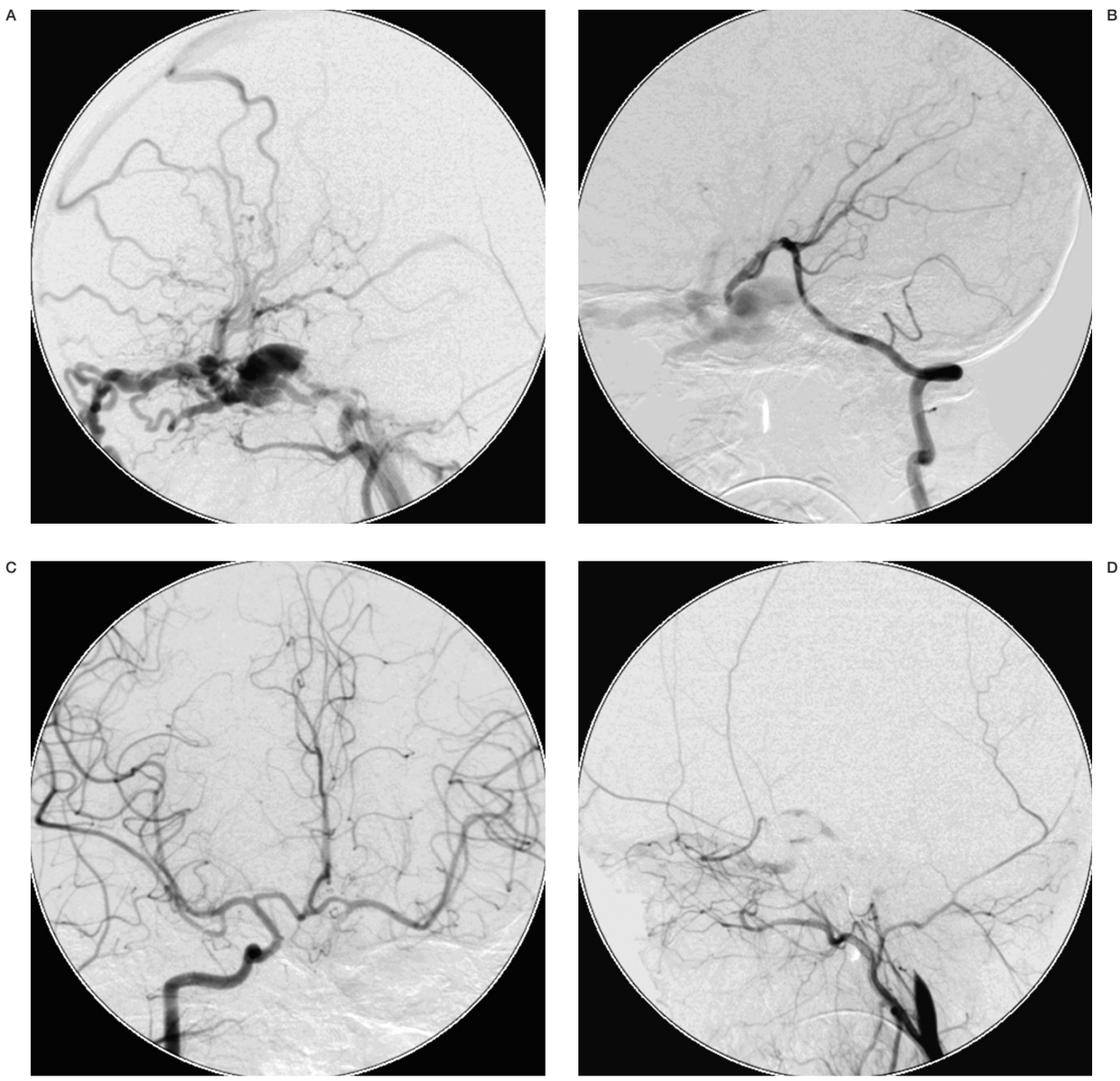

Figure 1 A) Left common carotid artery lateral DSA showed left high-flow CCF. The C4 segment of the left ICA was nearly transsected with absent filling of the ICA above the fistula. The blood leaked into the cavernous sinus from the left ICA directly with a venous drainage from the ipsilateral left sylvian vein to the longitudinal sinus, from the ipsilateral inferior anastomotic vein to the sigmoid sinus, from the ipsilateral deep vein to the tentorial sinus, from the ipsilateral inferior petrosal sinus to the sigmoid sinus, and from the ipsilateral superior ophthalmic vein-facial vein to the jugular vein respectively. B) Blood steal was from the posterior circle through the ipsilateral PComA. C) The feeding area of left ACA and MCA were compensated completely by the contralateral anterior circle through the AComA. D) The left maxillary artery communicated with the left ophthalmic artery and retro-engorged the fistula which was not occluded completely after the parent artery sacrificed.

anastomotic vein to the sigmoid sinus, from the ipsilateral deep vein to the tentorial sinus, from the ipsilateral inferior petrosal sinus to the sigmoid sinus, from the ipsilateral superior ophthalmic vein-facial vein to the jugular vein respectively (Figure 1A).

Blood stealing occurred from the posterior circle through the ipsilateral posterior communicating artery (PComA) (Figure 1B). The feeding area of the left anterior cerebral artery (ACA) and middle cerebral artery (MCA) were compensated completely by the contralateral

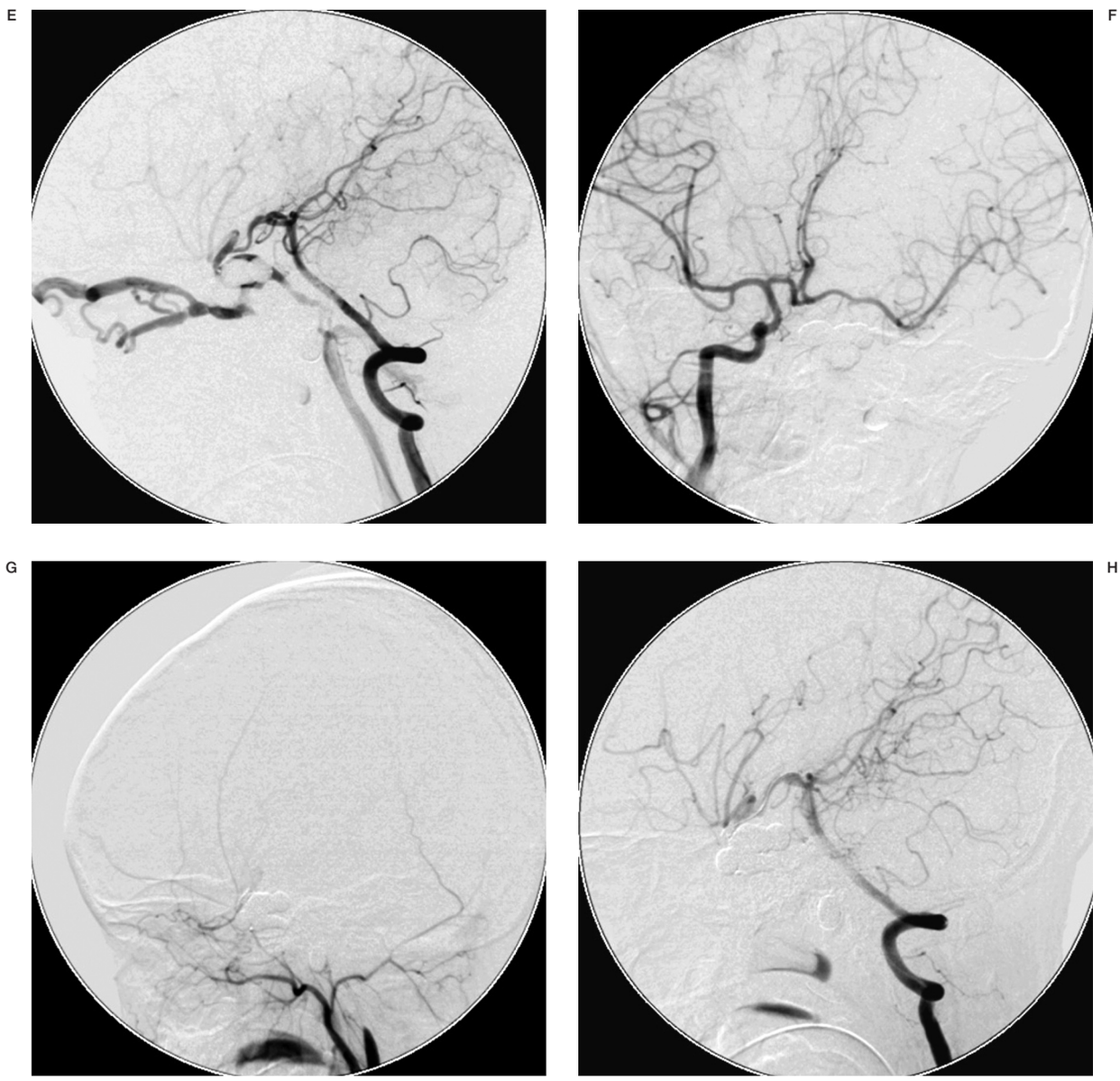

Figure 1 E) The blood engorged the incompletely occluded fistula orifice from the posterior circulation through the PComA and drained through the ipsilateral ophthalmic vein and the inferior petrosal sinus after the parent artery was sacrificed. F) The feeding area of the left ACA and MCA were compensated completely by the contralateral anterior circle through the AComA postprocedure. G) The residual fistula was obliterated by placement of microcoils. H) The residual fistula was obliterated and the feeding area of the left MCA was compensated partly by the post circle through the PComA.

anterior circle through the anterior communicating artery (AComA) (Figure 1C). Transarterial embolization with detachable balloons was suggested after a discussion with the patient and his relatives regarding alternative treatments. We chose a 6F guiding catheter considered the vessel of the child is too narrow for an 8F guiding catheter. According to our experience, detachable balloons cannot pass through the 6F guiding catheter smoothly except #1 balloons at that time. So #1 balloons were the only choice for this patient. A 6F Envoy guiding catheter (Cordis Corp., Miami Lakes, FL, USA) was advanced over a guidewire into the left ICA and four detachable #1 balloons (Balt Company, France) was implanted into the cavernous sinus

easily through the fistula orifice. The fistula could not been occluded completely when the fifth #1 detachable balloon was implanted while the parent artery was intruded. We tried to change the dilation of the balloon and find a better position in the cavernous sinus (CS) to occlude the fistula completely but the balloon detached unexpectedly during the regulation process. The proximal orifice of the fistula and the parent artery were occluded but the distal orifice of the fistula remained. The remnant fistula recruited blood from the posterior circulation. We could preserve the carotid blood flow and the parent artery was sacrificed unwillingly. A protectant #1 balloon was implanted into the petrosal segment of the left ICA. Left common carotid artery (CCA) digital subtraction angiography (DSA) showed an absent filling of the proximal occluded segment of the left ICA, but the left maxillary artery communicated with the left ophthalmic artery and retro-engorged the fistula which was not occluded completely (Figure 1D). Left vertebral artery (VA) DSA showed the blood engorged the incompletely occluded fistula orifice from the posterior circulation through the PComA and drained through the ipsilateral ophthalmic vein and the inferior petrosal sinus (Figure 1E). We introduced the guiding catheter into the left VA and inserted another microcatheter ExcelsiorSL-10 (Boston Corp., USA) into the fistula through the PComA. Four microcoils (Boston Corp., USA) were implanted and the fistula orifice was occluded completely (Figures 1F-H). Bilateral orbital bruit disappeared immediately after the procedure. Six days later, the eye exophthalmos, chemosis and conjunctival edema had notably improved while the left dys-oculomotor and diplopia persisted and then the patient was discharged. At three month follow-up postprocedure, the left eye exophthalmos, chemosis and conjunctival edema were completely resolved except for the dys-oculomotor and diplopia. We concluded these signs to be due to the oculomotor nerve injury caused by the puncture wound. The patient was discharged and scheduled for a one year follow-up after the procedure.

Discussion

Traumatic CCF most results from head injury which leads to a direct high-flow shunt between the ICA and the cavernous sinus, and belong to Type A classified by Barrow et Al[1]. Spontaneous resolution of these lesions is rare and transarterial embolization with detachable balloons provides a high rate of fistula obliteration with low morbidity and is the best initial procedure to treat direct carotid-cavernous fistulae[3]. Our patient exhibited left eye exophthalmos, chemosis, conjunctival edema, sight weakness, pupil dilatation, dys-oculomotor, diplopia and bilateral orbital bruit after the left temporal puncture wound and diagnosed by arteriocerebral angiography. Transarterial embolization with detachable balloons has been widely accepted as the preferred method for treating direct CCF with reported success rates of 75%–88% in preserving the patency of the parent ICA[5]. However, the size of the cavernous sinus and the fistula may affect the success of the detachable balloon embolization of a CCF[3].

These include the following:

1) a small orifice that does not permit the passage of the balloon easily, but one suitable balloon may achieve satisfactory embolization once the balloon reaches the right position;

2) the cavernous sinus or the orifice being too small to allow balloon insertion or causing the balloon to herniate into the parent ICA, microcoils as an alternative method may achieve the aim;

3) a markedly enlarged cavernous sinus or transsection of the cavernous ICA, the detachable balloon may migrate easily into the large cavernous sinus. Under this circumstance, multiple balloons are needed to fill the cavernous sinus and occlude the fistula even if the parent ICA is sacrificed. *n*-BCA as an embolizing agent has been used to occlude DCCFs and achieved promising results. Transarterial balloon-assisted *n*-BCA embolization should be considered an alternative treatment for those fistulae in which the use of detachable balloons fails to occlude the fistula and preserve the ICA[5]. Onyx as another alternative agent has been widely used with success for the treatment of arteriovenous malformations and dural arteriovenous fistulaes, but seldom used to treat traumatic CCF[7].

In our patient, the C4 segment of the left internal carotid artery was nearly transsected and multiple balloons implanted into the sinus could not obliterate the fistula. In the end, we sacrificed the parent artery unwillingly because of the unexpected balloon detaching. But the fistula was not occluded completely and the residual fistula was retro-engorged by the

branch of the external carotid artery and communicated with the ophthalmic artery and the posterior circle through the PComA. The balloons would have migrated or deflated early due to the blood flow that would lead to fistula recurrence[2] if the residual fistula was incompletely occluded. When the proximal segment of the ICA was occluded and the residual fistula located in the distal of the occluded segment still persisted, some remedies include:

1) choosing a suitable microcatheter to pass through the contralateral ICA-AComA approach or ipsilateral vertebral basilar artery-PComA approach, implanting suitable microcoils to embolize the residual fistula;

2) through the superior ophthalmic vein, superior petrosal sinus or inferior petrosal sinus approach, implanting microcoils or Onyx to obliterate the cavernous sinus and the residual fistula. In our patient, the AComA and the ipsilateral PComA were all patent, the ophthalmic-facial vein and the inferior petrosal sinus were all unobstructed. We embolized the residual fistula through the ipsilateral PComA approach because it was the shortest route and easy to manipulate. If we fail to occlude the fistula completely through this way, endovascular trapping by proximal balloon occlusion and distal coiling of the parent vessel may be the last endovascular rescue[6].

Conclusions

In conclusion, we successfully occluded a poorly treated CCF completely through the PComA with coils though the ICA had to be sacrificed. Once the parent artery was sacrificed and the distal residual fistula still retro-engorged, another patent communicating artery or vein will obtain satisfactory rescue.

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